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ITEM OF INTEREST

Prepared by
Science and Technology Section
Air Information Division

SUBJECT: Uranium Carbide

SOURCE: Meyerson, G. A., R. B. Kotel'nikov, and S. N. Bashlykov. Uranium carbide. Atomnaya energiya, v. 9, no. 5, Nov 1960, 387-391. QC770.A83, v. 9

The results of a study of the effect of production conditions on the composition of uranium carbide are presented. The conditions studied included sintering and hot extrusion of UC powders and sintering of UC + U alloys. An optimum regime for obtaining stoichiometric UC was established.

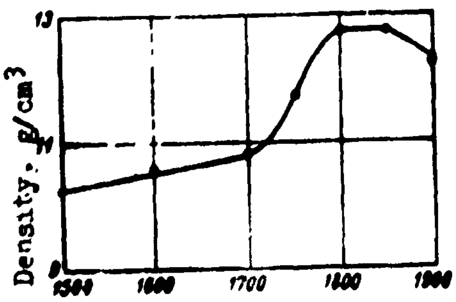
The initial mixture of uranium dioxide and carbon black was prepared according to the equation:

$$UO_2 + 3C \longrightarrow UC + 2CO.$$

Compacts of the initial mixture placed in beryllium oxide crucibles were sintered under various regimes in a vacuum furnace with graphite heating elements. The UC briquets obtained were then ground into powder with particle sizes less than 10-15 microns.

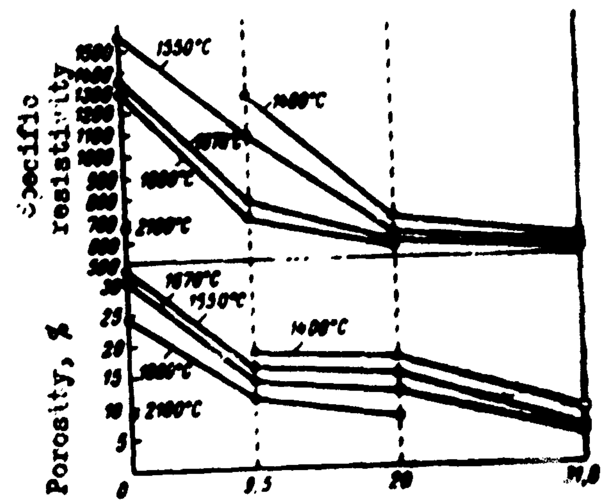
For hot extrusion of UC specimens, the graphite extrusion die was placed in a hermetically sealed metal vacuum chamber in which a pressure of about 10 mm Hg was maintained. The effect of extrusion pressure, temperature (Figure 1), and time on specimen density were studied. To prevent carbonizing of UC to UC_2 as a result of contact with the graphite die, a molybedenum-foil lining was used. Temperature increases above 1850° C resulted in failure of the protective foil and reduction in specimen density. The porosity of hot-extruded specimens with length to diameter ratio equal to one was about 5%.

Compacts of UC powder and UC + U mixtures with varying uranium content (9.5-31.8% by weight) were placed in a graphite crucible and sintered in a vacuum furnace with graphite heating elements. The crucible bottom was covered with zirconium carbide or tantalum. After sintering for 2 hours at 2200°C, the porosity of UC was found to be about 10%. The introduction of metallic uranium sharply increased the density. With uranium content of 25% by volume (31.8% by weight) and 2 hours sintering at 1700°C, it was possible to obtain a specimen with porosity of 5% or less.



Extrusion temperature, 0°C

Figure 1. Relationship between density of hot-extruded specimens and extrusion temperature (p = 300 kg/cm^2; t = 5 min)



Uranium content, %

Figure 2. Relationship of porosity and electric resistivity of sintered UC + U specimens to uranium additions and sintering temperature (Holding time, 2 hr).

The thermal conductivity of UC in the temperature range of 100-700°C varied from 0.028 to 0.04 cal/cm sec °C. Mean thermal coefficient of linear expansion in the temperature range of 20-1500° C was 11.6×10^{-6}. UC specimens subjected to isothermal heat treatment between 200 and 1000° C withstood 500 cycles without fracture; UC + U specimens withstood more than 1000 cycles.

High uranium-atom density, good thermal conductivity, and radiation stability make uranium carbide a promising fuel material. Herbert Kalish of the Olin Mathieson Chemical Corporation (Power, December 1960, 122) notes that one of the major problems in the use of UC for such purposes centers around finding an economic method of fabricating the compound under good control. This article is of interest then, because it presents data related to the problem of controlled production of uranium carbide.